

Application No. 10/753,138

Reply to Office Action

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listing, of claims in the application.

Listing of the Claims:

1. (Currently Amended) A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:
 - (a) providing a substrate comprising a metal in an oxidized form, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof,
 - (b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:
 - (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
 - (ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hypophosphorous acid, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and
 - (iii) a liquid carrier, andwherein the polishing system does not comprise a component having a standard redox potential that is greater than the standard redox potential of the metal in an oxidized form, and
 - (c) abrading at least a portion of the metal in an oxidized form to polish the substrate.
2. (Original) The method of claim 1, wherein the oxidized form is selected from the group consisting of oxides, nitrides, borides, sulfides, and mixtures thereof.
3. (Previously Presented) The method of claim 1, wherein the oxidized form is an oxide, and the metal in an oxidized form has a molecular formula M_xO_y in which M represents the metal and x and y represent integers, where y is greater than or equal to x.
4. (Canceled)
5. (Canceled)

Application No. 10/753,138

Reply to Office Action

6. (Previously Presented) The method of claim 2, wherein the metal in an oxidized form is iridium oxide.

7. (Previously Presented) The method of claim 1, wherein the reducing agent is selected from the group consisting of dimethylamine borane, formic acid, hydroquinone, hydroquinone sulfonic acid, hypophosphorous acid, trihydroxybenzenes, salts thereof, and mixtures thereof.

8. (Original) The method of claim 7, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier, and the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

9. (Original) The method of claim 8, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

10. (Original) The method of claim 8, wherein the abrasive comprises α -alumina.

11. (Canceled)

12. (Canceled)

13. (Previously Presented) The method of claim 1, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier and the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

14. (Original) The method of claim 13, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

15. (Original) The method of claim 13, wherein the abrasive comprises α -alumina.

16. (Original) The method of claim 1, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier.

Application No. 10/753,138

Reply to Office Action

17. (Original) The method of claim 16, wherein the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

18. (Original) The method of claim 17, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

19. (Original) The method of claim 17, wherein the abrasive comprises α -alumina.

20. (Canceled)

21. (Original) The method of claim 1, wherein the chemical-mechanical polishing system comprises about 0.1 to about 5 wt.% reducing agent based on the weight of the liquid carrier and any components dissolved or suspended therein.

22.-30. (Canceled)

31. (Canceled)

32. (Previously Presented) The method of claim 1, wherein the liquid carrier comprises water.

33. (Previously Presented) The method of claim 1, wherein the chemical-mechanical polishing system further comprises a complexing agent.

34. (Previously Presented) The method of claim 1, wherein the chemical-mechanical polishing system further comprises a pH buffering agent.

35. (Previously Presented) The method of claim 1, wherein the chemical-mechanical polishing system further comprises a surfactant.

36. (Currently Amended) A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

(a) providing a substrate comprising a metal in an oxidized form, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof,

Application No. 10/753,138

Reply to Office Action

- (b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:
- (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
 - (ii) about 0.1 to about 1 wt.% of a reducing agent based on the weight of the liquid carrier and any components dissolved or suspended therein, the reducing agent being selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, ascorbic acid, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hypophosphorous acid, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and
 - (iii) a liquid carrier, and
- wherein the polishing system does not comprise a component having a standard redox potential that is greater than the standard redox potential of the metal in an oxidized form, and
- (c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

37. (Previously Presented) The method of claim 36, wherein the chemical-mechanical polishing system comprises about 0.1 to about 0.5 wt.% reducing agent based on the weight of the liquid carrier and any components dissolved or suspended therein.

38. (Previously Presented) A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

- (a) providing a substrate comprising a metal in an oxidized form, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof,
- (b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:
 - (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
 - (ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hypophosphorous acid, a metal or metal ions in an oxidation state having a standard redox potential that is less than the standard redox potential of the

Application No. 10/753,138

Reply to Office Action

metal in an oxidized form, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and

(iii) a liquid carrier,

wherein the polishing system does not comprise an oxidizing agent, and

(c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

39. (Currently Amended) A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

- (a) providing a substrate comprising a metal in an oxidized form, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof,
- (b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:
- (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof, wherein the polishing component does not comprise a mixture of α -alumina and fumed alumina,
- (ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hypophosphorous acid, phosphorous acid, a metal or metal ions in an oxidation state having a standard redox potential that is less than the standard redox potential of the metal in an oxidized form, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and
- (iii) a liquid carrier, ~~and~~
- wherein the polishing system does not comprise a component having a standard redox potential that is greater than the standard redox potential of the metal in an oxidized form, and
- (c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

40. (New) The method of claim 1, wherein the polishing composition has a pH of about 1 to about 7.

41. (New) The method of claim 36, wherein the polishing composition has a pH of about 1 to about 7.

Application No. 10/753,138

Reply to Office Action

42. (New) The method of claim 38, wherein the polishing composition has a pH of about 1 to about 7.

43. (New) The method of claim 39, wherein the polishing composition has a pH of about 1 to about 7.